

This C&NN resource includes an executive summary of each research report; full citation; and a PDF if available, or a link to each study in its entirety, or contact information if the study is not available online. Some are reports of individual studies in the form of original research; others are a synthesis of reports of various studies. While this is a listing of a sample of outstanding studies, the listing is not intended to be exhaustive. We welcome recommendations for additional research to include. **Please send suggestions, with a PDF or link to the original study, to the attention of Cheryl Charles, Ph.D., President, Children & Nature Network, Cheryl@cnaturenet.org.**

These research reports meet criteria for:

- **Scholarly excellence;**
- **Original research or well-documented syntheses of original research;**
- **Contribution to understanding the benefits from connecting children and nature;**
- **Addressing significant categories of benefits, e.g., health, school achievement, problem-solving, creativity and self-discipline;**
- **Providing insights and recommendations for policies and actions people can take, from back yards to schoolyards, neighborhoods to municipalities.**

Nature Is Important to Children's Overall Development

Direct Experience in Nature Is Critical and Diminishing

Nature is important to children's development in every major way — intellectually, emotionally, socially, spiritually, and physically. In his newest book, *Building for Life: Designing and Understanding the Human-Nature Connection* (Island Press, 2005), Dr. Stephen R. Kellert of Yale University devotes a chapter to the subject of "Nature and Childhood Development." Combining his original research with well-documented references to the research of others, this chapter is a powerful synthesis of what we know, and what we do not know, about the importance of nature to children's healthy development. Kellert states, "Play in nature, particularly during the critical period of middle childhood, appears to be an especially important time for developing the capacities for creativity, problem-solving, and emotional and intellectual development." He includes research to indicate optimal learning opportunities at age-appropriate times and differentiates between indirect, vicarious, and direct experiences with nature — with the latter less and less available to children. He urges designers, developers, educators, political leaders

and citizens throughout society to make changes in our modern built environments to provide children with positive contact with nature — where children live, play, and learn. (Original Research and Synthesis)

Kellert, Stephen R. "Nature and Childhood Development." In *Building for Life: Designing and Understanding the Human-Nature Connection*. Washington, D.C.: Island Press, 2005. Full book available via Amazon.com and other commercial sources.

http://www.cnaturenet.org/02_rsrch_studies/PDFs/Kellert_BuildingforLife.pdf (Chapter 3).

Unstructured Free Play Brings Cognitive, Social and Health Benefits to Children

Unstructured free play in the out-of-doors brings a host of benefits to children — from being smarter to more cooperative to healthier overall. This well-documented article by two physicians builds a strong case for the importance of unstructured free play in the out-of-doors for all age groups, and especially young children. While concerned about the “obesity epidemic” in young children, the authors say that the health benefits from outdoor play are only one aspect of the overall benefits. They suggest that the concept of “play” is more compelling and inviting to most adult caregivers, parents and guardians than “exercise.” The authors cite cognitive benefits from play in nature, including creativity, problem-solving, focus and self-discipline. Social benefits include cooperation, flexibility, and self-awareness. Emotional benefits include stress reduction, reduced aggression and increased happiness. Children will be smarter, better able to get along with others, healthier and happier when they have regular opportunities for free and unstructured play in the out-of-doors. (Synthesis)

Burdette, Hillary L., M.D., M.S.; and Robert C. Whitaker, M.D, M.P.H. "Resurrecting Free Play in Young Children: Looking Beyond Fitness and Fatness to Attention, Affiliation and Affect."

© 2005 American Medical Association.

http://www.cnaturenet.org/02_rsrch_studies/PDFs/Burdette_LookingBeyond.pdf

Direct Experience and Mentoring Are Key Elements

The focus of this recent research from Dr. Louise Chawla is on those factors that contribute to individuals choosing to take action to benefit the environment when they are adults. This is a reprise of earlier research by Dr. Chawla in the 1990s (*Journal of Environmental Education*, 1998, 1999). Positive, direct experience in the out-of-doors and being taken outdoors by someone close to the child — a parent, grandparent, or other trusted guardian — are the two most significant contributing factors. While lifelong activism is the primary focus of Dr. Chawla’s inquiry, as reported in this article, her well-documented study includes citations and explanations of many additional benefits to children from early experiences in the out-of-doors. Creativity, physical competence, social skills, environmental knowledge, confidence, and problem-solving ability are among those benefits to children’s development. Given the important role of adults in taking children into the out-of-doors, Dr. Chawla is specific about the attributes of the experiences those adult mentors provide. She states, the “adults gave attention to their surroundings in four ways — care for the land as a limited resource essential for family identity and well-being; a disapproval of destructive practices; simple pleasure at being out in nature; and a fascination with the details of other living

things and elements of the earth and sky.” Modeling those attributes while in the presence of the child does even more. As Dr. Chawla states, “The very fact that a parent or grandparent chose to take the child with them to a place where they themselves found fascination and pleasure, to share what engaged them there, suggests not only care for the natural world, but, equally, care for the child.”

(Original Research and Synthesis)

Chawla, Louise. “Learning to Love the Natural World Enough to Protect It,” in *Barn* nr. 2 2006:57-58. © 2006 Norsk senter for barneforskning. *Barn* is a quarterly published by the Norwegian Centre for Child Research at the Norwegian University of Science and Technology, Trondheim, Norway. This article was written for a special issue in honor of the Norwegian child psychologist, Per Olav Tiller.

http://www.cnaturenet.org/02_rsrch_studies/PDFs/Chawla_LearningtoLove.pdf

Contact with Nature Is Important for Children

Andrea Faber Taylor and Frances E. Kuo have contributed important research to the understanding of the impact of nature on people’s lives, and specifically to the well-being of children. This particular article is a recent review of the literature and establishes what is known, and what is still missing, about the effects of contact with nature on children’s lives. While the evidence is growing, this article is an important call to action for further research.

Taylor, Andrea Faber; and Frances E. Kuo. “Is Contact with Nature Important for Healthy Child Development? State of the Evidence.” In Spencer, C. & Blades, M. (Eds.), *Children and Their Environments: Learning, Using and Designing Spaces*. Cambridge, UK: Cambridge University Press, 2006.

<http://www.lhhl.uiuc.edu/documents/Faber2006Iscontactwithnature.pdf>

Outdoor Learning Enhances School Achievement, Self-Esteem and Self-Discipline

Nature-Smart Kids Get Higher Test Scores

The American Institutes for Research® conducted a study, submitted to the California Department of Education, of the impact of weeklong residential outdoor education programs. The focus was on at-risk youth, 56% of whom reported never having spent time in a natural setting. Comparing the impact on students who experienced the outdoor education program versus those in a control group who had not had the outdoor learning experience, results were statistically significant. Major findings were: 27% increase in measured mastery of science concepts; enhanced cooperation and conflict resolution skills; gains in self-esteem; gains in positive environmental behavior; and gains in problem-solving, motivation to learn, and classroom behavior. (Original Research)

“Effects of Outdoor Education Programs for Children in California.” American Institutes for Research: Palo Alto, CA: 2005. Available on the Sierra Club web site.

http://www.sierraclub.org/youth/california/outdoorschool_finalreport.pdf

Environment-Based Learning Enhances School Achievement and Civic Responsibility

School Achievement Is Enhanced When Curricula Are Environment Based

Sponsored by many state departments of education, this 1998 study has an important place in documenting the enhanced school achievement of youth who experience school curricula in which the environment is the principal organizer. This study, completed in 1998, was followed by two related studies, conducted by the State Education and Environment Roundtable (SEER), both of which produced results consistent with this original study. (Original Research)

Lieberman, Gerald A.; and Linda L. Hoody. "Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning." SEER: Poway, CA, 1998.

"California Student Assessment Project." SEER: Poway, CA, 2000.

The third and most recent of the SEER studies we are featuring is described below.

Available on the Web site of the State Education and Environment Roundtable (SEER) at www.seer.org

More Evidence Corroborates Environment-Based School Achievement

This study provides further evidence to support the positive benefits on school achievement from environment-based study in schools. This 2005 study is consistent with the results of two precursor studies, cited above, "Closing the Achievement Gap" (1998) and the "California Student Assessment Project" (2000). Students in environment-based instructional programs score as well or better on standardized measures in four basic subject areas — reading, math, language and spelling. The environment-based programs also foster cooperative learning and civic responsibility, using the natural characteristics of the school grounds and local community as the foundational framework for the curricula. While the benefits are significant, this study also provides evidence for the challenges inherent in maintaining environment-based curricula in schools on a longitudinal basis, despite substantial evidence of benefits. (Original Research)

"California Student Assessment Project Phase Two: The Effects of Environment-Based Education on Student Achievement." SEER: Poway, CA, 2005. (Original Research)

Available on the Web site of the State Education and Environment Roundtable (SEER) at www.seer.org

Outdoor Experience for Teens Has Self-Reported Life-Changing Results

A classic 1998 study by Dr. Stephen R. Kellert of Yale University, with assistance from Victoria Derr, remains the most comprehensive research to date to examine the effects on teenage youth of participation in outdoor education, specifically wilderness-based programs. Subjects were participants in programs offered through three old and well-respected organizations: the Student Conservation Association (SCA), the National Outdoor Leadership School (NOLS), and Outward Bound. The researchers used quantitative and qualitative research techniques, and parallel use of both retrospective and longitudinal study techniques. Results indicate that the majority of respondents found this outdoor experience to be "one of the best in their life." Participants report positive effects on their personal, intellectual and, in some cases, spiritual development. Pronounced results were

found in enhanced self-esteem, self-confidence, independence, autonomy and initiative. These impacts occurred among both the retrospective and longitudinal respondents in this study, which means, in part, that these results persisted through many years.

Kellert, Stephen R.; with the assistance of Victoria Derr. "A National Study of Outdoor Wilderness Experience." New Haven: Yale University, 1998.

<http://www.nols.edu/resources/research/pdfs/kellert.complete.text.pdf>

Naturalized School Grounds Enhance Creativity, Self Discipline, Health and Academic Achievement

Green School Grounds Foster Achievement and Responsibility

There are numerous studies that document the benefits to students from school grounds that are ecologically diverse and include free-play areas, habitat for wildlife, walking trails, and gardens. One major study is "Grounds for Action: Promoting Physical Activity through School Ground Greening in Canada" by Anne C. Bell and Janet E. Dymnt. While this study has roots in concern about obesity in children, it documents results and benefits beyond weight loss. Children who experience school grounds with diverse natural settings are more physically active, more aware of nutrition, more civil to one another, and more creative. One of the major benefits of green school grounds is increased involvement by adults and members of the nearby community, from helping with gardens to enriching the lifescape of the school grounds. Concerned about policy implications, this report offers specific recommendations for actions communities can take, from local neighborhoods to cities, states, and provinces. (Original Research)

Bell, Anne C.; and Janet E. Dymnt. "Grounds for Action: Promoting Physical Activity through School Ground Greening in Canada." © 2006 Evergreen.

<http://www.evergreen.ca/en/lg/pdf/PHACreport.pdf>

Naturalized School Grounds Benefit Children and Communities

A precursor to the study above, this report, "Nature Nurtures: Investigating the Potential of School Grounds," is an important compendium of documented benefits from "greening" school grounds. It includes citations of benefits to students, from improved academic performance to lower exposure to toxins; benefits to teachers, from increased enthusiasm for teaching to fewer classroom discipline problems; benefits to schools, from reduced absenteeism to fewer discipline problems; and benefits to communities, from better community health to "banked social capital." The report provides recommendations and tangible examples of ways to transform traditional school grounds into "green" school grounds for enriched learning and other benefits. (Synthesis)

"Nature Nurtures: Investigating the Potential of School Grounds." © 2000 Evergreen.

<http://evergreen.ca/en/lg/naturenurtures.pdf>

There Are More Benefits from Naturalized Playgrounds and School Grounds – and Ways to Achieve Them

Randy White offers a variety of resources, articles, and recommendations for designing school grounds and playgrounds to optimize the benefits to children's development. One of his many excellent articles is "Young Children's Relationship with Nature: Its Importance to Children's Development & the Earth's Future." In addition to citing references and providing a succinct summary of the many benefits of informal and unstructured natural play environments for children, he distills the findings into a list of beneficial elements of naturalized play environments that any of us can use, from back yards to school grounds to neighborhood parks. Visit Randy White's Web site for additional resources and information at www.whitehutchinson.com. (Synthesis)

White, Randy. "Young Children's Relationship with Nature: Its Importance to Children's Development & the Earth's Future."

http://www.cnaturenet.org/02_rsrch_studies/PDFs/White_YoungChildren.pdf

Schoolyard Habitat Projects Bring Natural Benefits to School and Students

This brief article by Mary Rivkin is an important reminder of the importance of bringing natural habitats to school grounds as places for natural learning. When the article was written in 1997, there was a burgeoning movement in the U.S. to have schoolyard habitat projects — places of natural and rich learning, integral to the curriculum, and a respite for teachers, students and the community overall. We've literally lost ground in this respect. The concept remains accessible, important, and healthy. This article is a short, succinct summary of the natural benefits afforded from schoolyard habitat projects. (Synthesis)

Rivkin, Mary. "The Schoolyard Habitat Movement: What It Is and Why Children Need It." *Early Childhood Education Journal*. Volume 25, No. 1, 1997.

<http://www.nwf.org/schoolyard/movement.cfm>

Natural Settings Provide Psychological Benefits

"Coping with ADD: The Surprising Connection to Green Play Settings," by Andrea Faber Taylor; Frances E. Kuo; and William C. Sullivan (2001) is one of the earliest studies to explore the potential for contact with nature to have a positive effect in reducing the impact of attention deficit disorder in children. The study was designed to test two hypotheses: 1) Attention deficit symptoms will be more manageable after activities in green settings than after activities in other settings; and 2) The greener a child's everyday environment, the more manageable their attention deficit symptoms will be in general. The results were positive. (Original Research)

Taylor, Andrea Faber; Frances E. Kuo; and William C. Sullivan. In *Environment and Behavior*, Vol. 33, No. 1, January 2001. © 2001 Sage Publications, Inc. Available on the web site of the University of Illinois Urbana-Champaign. <http://www.lhhl.uiuc.edu/>

Nature Activities Soothe ADD Symptoms

Contact with the natural world can significantly reduce symptoms of attention deficit disorder in children as young as five. Here is another important study that supports this finding. In addition to access to reports of the primary research, the

scholars provide a Power Point presentation that may be used in communities to disseminate this positive information based on sound research. (Original Research) Kuo, Frances E.; and Andrea Faber Taylor. "A Potential Natural Treatment for Attention-Deficit/Hyperactivity Disorder: Evidence from a National Study." In *American Journal of Public Health*, Vol 94, No. 9, September 2004. © American Public Health Association. The study and the educational Power Point are available on the web site of the University of Illinois Urbana-Champaign. <http://www.lhhl.uiuc.edu/>

Access to Nature Nurtures Self-Discipline

This study focuses on the positive benefits to inner city youth, particularly girls, from access to green spaces for play. Even a view of green settings enhances peace, self-control, and self-discipline. While the results are most notable for girls, the evidence is not limited to the positive impact on girls. (Original Research)

Taylor, Andrea Faber; Frances E. Kuo; and William C. Sullivan. "Views of Nature and Self-Discipline: Evidence from Inner City Children." In the *Journal of Environmental Psychology*, 21, 2001. © 2001 Academic Press. Available on the Web site of the University of Illinois Urbana-Champaign. <http://www.lhhl.uiuc.edu/>

Nearby Nature Reduces Stress in Children

This study, reported in 2003, by Cornell assistant professor Nancy Wells, focuses on rural children and finds that even a view of nature — green plants and vistas — helps reduce stress among highly stressed children. Further, the more plants, green views and access to natural play areas, the more positive the results. (Original Research)

Wells, N.M., and Evans, G.W. "Nearby Nature: A Buffer of Life Stress Among Rural Children." *Environment and Behavior*. Vol. 35:3, 311-330. This study is not available online without purchase; <http://www.sagepub.co.uk/journals/details/j0163.html>

Nearby Nature Boosts Children's Cognitive Functioning

A precursor to Nancy Wells' study reported above, this research, reported in 2000, shows that proximity to, views of, and daily exposure to natural settings increases children's ability to focus and therefore enhances cognitive abilities. (Original Research)

Wells, N.M. "At Home with Nature: Effects of 'Greenness' on Children's Cognitive Functioning." *Environment and Behavior*. Vol. 32, No. 6, 775-795. This study is not available online without purchase; <http://eab.sagepub.com/cgi/content/abstract/32/6/775>

Design Places for Learning and Living with Children in Mind

Design Cities Where Children Can Play and Learn Independently

City planners and city leaders need to create safe and accessible places for children to play. As more and more children live in urban settings, cities need to be redesigned with children in mind. This study offers explicit evidence for the importance of natural play areas in cities, and suggestions for actions to take to achieve this outcome. The study includes a summary of the characteristics of cities and neighborhoods that need to be considered in order to create safe places

for children to play independently, with all of the associated and documented benefits that will result. (Original Research)

Churchman, Arza. "Is There a Place for Children in the City." In the Journal of Urban Design, Volume 8, No 2, 99-111, June 2003. Available on the Web site of the University of North Carolina, College of Design, Natural Learning Initiative www.naturalearning.org

City Parks Bring Social, Community Health and Economic Benefits

The Trust for Public Land (TPL) is a premier conservation organization, responsible for protection of special public lands throughout several generations. Today TPL is concerned not just about setting lands aside for future generations, but making sure that young people and families enjoy them today. TPL recognizes that to connect with nature is to appreciate nature, now and for the long term. This comprehensive report, "The Benefits of Parks: Why America Needs More City Parks and Open Space," offers a clear look at socioeconomic factors affecting the availability of parks, the history of city parks, and the hopes for a revival of commitment to city parks. The report outlines benefits in a number of areas: physical, including remedies for inactivity and obesity; economic, with increased property values; environmental, with pollution abatement; and social, from crime reduction to strengthening communities. Add this report to your collection of those that serve to document how safe places for children to play contribute to everyone's health and well being. (Synthesis)

http://www.tpl.org/content_documents/parks_for_people_Jul2005.pdf

City Parks Offer a Sense of Place

This brief article draws on solid research, some of which is independently referenced elsewhere in this list. Among the points made are that city parks offer a sense of place, opportunity for daily experience with nature, experiences that enhance school achievement, and antidotes to alienation. This American Planning Association City Parks Forum Briefing Paper is largely inspired by the work of Robin Moore, noted and pioneering landscape designer with a commitment to creating learning landscapes that optimize children's learning. "Natural spaces and materials stimulate children's limitless imaginations and serve as the medium of inventiveness and creativity," says Moore. Readers will find tangible reasons for the benefits associated with using city parks as places for learning as well as community-based examples and resources. (Synthesis)

"How Cities Use Parks to . . . Help Children Learn," Chicago, IL: American Planning Association, 2003.

Available on line at www.naturalearning.org and www.planning.org.

Texas Parks and Wildlife Department has provided funding to the Children & Nature Network (C&NN) in order to have C&NN "research and provide an executive summary of 20 premier research reports supporting the importance of connecting children and nature." The information is made available on the Children & Nature Web site, www.cnaturenet.org.